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(57) Abstract

The present invention relates to an agricultural composition, containing as an active ingredient glycolic acid, for controlling crop growth and for the maintenance of irrigation systems. In its preferred embodiment the said composition is an aqueous solution containing up to about 72 % by weight glycolic acid comprising a mixture of glycolic acid and phosphoric acid and/or metal ion compounds, preferably bivalent metal ions. The agricultural composition of the present invention can be used as a fertilizer; it is useful in macro element nutrition and in micro element nutrition. This agricultural composition is also useful for controlling the pH level of the irrigation water and of a non soil bed and is useful as an antimicrobial or a bacteriostat. The agricultural composition of the present invention is further useful in maintenance of irrigation systems by chelating calcium deposits, or the like, in the irrigation lines and by acting as an antimicrobial or a bacteriostat keeping the irrigation lines clean of alga and the like and sanitizing the soil. The agricultural composition of the present invention is more effective in agricultural use, than the presently used compositions and it is easily biodegradable, thus it provides a cheap and "environment friendly" composition for agricultural use.

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AGRICULTURAL COMPOSITIONS CONTAINING GLYCOLIC ACID

Field of the Invention

The present invention relates generally to agricultural compositions containing glycolic acid as active ingredient. More specifically the present invention relates to glycolic acid containing compositions useful for controlling crop growth, including non soil crops, and for the maintenance of irrigation systems. The said agricultural compositions are useful as fertilizers, exploiting unique characteristics of glycolic acid, such as its ability of chelating and its anti microbial activity. These compositions are further useful in cleaning irrigation systems and in maintenance of these systems, exploiting the unique characteristics of glycolic acid, such as its low corrosiveness, its ability of chelating, its effective control of pH and its biodegradation.

Background of the Invention

In modern agriculture, effective and profitable crop growth is a result of a combination of parameters. These parameters are to be considered in the irrigation and feeding of nutritious additives to plants, greens, flowers and other agriculture cultivated areas.
The term "crop growth" in this invention includes crops grown on soil and non soil crops such as crops grown on synthetic plant beds and such as picked plants.
Macro elements - The macro elements used in plant nutrition are mainly nitrogen (N), phosphates (P) and potassium (K). P elements are provided by costly fertilizers. The use of a low cost fertilizer such, as ammonium, is not effective because of its chemical nature which contributes to lowering phosphate availability.
Micro elements - micro elements are trace elements, provided in the plants nutrition, such as salts of magnesium, iron, molybdenum and calcium. The known methods for micro element feeding are based on using chelating agents for creating a soluble solution available to the plant. The conventional chelating agents used are mainly ethyl di amine tetra acetic acid (EDTA) derivatives such as EDDHMA or EDHA or citrate products. These agents are high molecular weight carrier molecules, they are inefficient in agricultural use and require a narrow pH spectrum. Furthermore, these chelating agents are not biodegradable - an important trait for agricultural compositions, and large

quantities of the above mentioned salts and chelating agents are required, making this treatment very costly and unfriendly to the environment.

Control of pH levels - As in all biological systems, a preferable surrounding for crops is of a pH of about 5.5. Such a slightly acidic environment is also preferable for the irrigation system since it helps to prevent formation of calcium deposits inside the irrigation lines. To achieve a stable pH level (commonly of 4 - 6.5) mineral acids are used. These acids have a long term damaging effect both on the soil and on the watering systems. Salts like calcium phosphate or magnesium sulfate, used for achieving a stable pH level, are very difficult to elimination and are hazardous for the user and for the environment.

Control of contamination levels - Sterilization of the soil is commonly achieved by use of harmful chemicals applied to the soil, such as methyl bromide and formaldehyde. The sterilization process requires a large quantity of chemicals which are hazardous for the user and for the environment. Non soil plant beds are commonly sterilized by addition of biocides to the irrigation water through a separate system, requiring maintenance of separate systems.

Maintenance of the soil and irrigation systems - irrigation lines must be seasonally cleaned of scale and calcium deposits, to avoid clogging of the system. Commonly, mineral acids or chlorine are used but these have the side effect of damaging metal pipes and of long term contamination of the soil.

Surprisingly, the use of agricultural compositions containing glycolic acid as an active ingredient, as described in the present invention, overcomes all of the problems posed by the commonly used methods.

Glycolic acid is an alpha hydroxy carboxylic acid of the general formula: $OHCH_2COOH$. Although it occurs naturally as a trace component in sugarcane, beets, grapes and fruits, the vast majority of commercial material is manufactured synthetically. Glycolic acid has a unique combination of properties that make it adaptable and easy to handle: low corrosiveness, negligible volatile organic compounds (VOC), nonflammability, low odor , low toxicity, biodegradability and high water solubility.

Glycolic acids' dual chemical functionality (acid and alcohol) makes it a useful organic chemical intermediate.

Glycolic acids' ability to chelate metal salts allots it many uses in household and industrial cleaning applications. In the regulatory use registration of the US Department of

Agriculture glycolic acid is listed for use as a cleaner in food processing equipment. It is marketed as an industrial cleaner for stainless steel boilers, heat exchangers etc. and is involved in many industrial processes because of its ability, by chelating, to prevent unwanted precipitates.

Many studies have shown glycolic acid to have extensive anti microbial activity. It has indicated activity against E. Coli, Staphylococcus, Salmonella, Lysteria and against Mycobaterium Phei and Mycobaterium Smegmatis in dairy products, Gallionella Ferruginea in water wells and against mildew such as Asperillus fungus. It may be used as a disinfectant whereas 1-5% concentration kills in 60 seconds, and may be used as a preservative whereas 250-750 ppm concentration kills in 24 hours.

Over the past few years, a new use for glycolic acid has emerged in personal care products as an exfoliate (removes the outer layer of dead skin cell). Many low priced cosmetics , such as hair care products, skin care and soap products containing glycolic acid are being prepared for marketing.

In the past, high purity grades of glycolic acid were the only option for agricultural use. A low cost product is now available for use in agriculture due to the ability to reduce impurities such as sulfates and chloride. Exploiting glycolic acids' attributes, the present invention discloses agricultural compositions containing glycolic acid as an active ingredient. These compositions are useful for controlling crop growth and for maintenance of irrigation systems. Glycolic acid is a more efficient chelator and sanitizer than the reagents used in agriculture today, and it is more friendly to the environment. Therefor, the present invention provides a much cheaper, more effective and less hazardous method of controlling crop growth and maintenance of irrigation systems, than the methods known today.

Summary of the invention

The present invention relates to an agricultural composition, containing as an active ingredient glycolic acid, for controlling crop growth and for the maintenance of irrigation systems. In its preferred embodiment the said composition is an aqueous solution containing up to about 72% by weight glycolic acid comprising a mixture of glycolic acid and phosphoric acid and/or metal ion compounds. The metal ions are preferably bivalent metal ions selected from: iron, zinc, copper, manganese, molybdenum, calcium, magnesium.

The agricultural composition of the present invention can be used as a fertilizer; it is useful in macro element nutrition and in micro element nutrition. This agricultural composition is also useful for controlling the pH level of the irrigation water and of a non soil bed and is useful as an antimicrobial or a bacteriostat. The agricultural composition of the present invention is further useful in maintenance of irrigation systems by chelating calcium deposits, or the like, in the irrigation lines and by acting as an antimicrobial or a bacteriostat keeping the irrigation lines clean of alga and the like and sanitizing the soil.

The agricultural composition of the present invention is more effective in agricultural use, than the presently used compositions and it is easily biodegradable, thus it provides a cheap and "environment friendly" composition for agricultural use.

Detailed description of the invention

The present invention relates to agricultural compositions containing glycolic acid as an active ingredient, useful for controlling crop growth, also for non soil crops, and for maintenance of irrigation systems.

In modern agriculture there are a number of parameters that must be considered for successful crop growth (these parameters are described in detail in the background of the invention). Glycolic acid has the following advantages, concerning these parameters:

Glycolic acids' chelating capacity is five times that of EDTA derivatives and ten times that of citrate products. One molecule of glycolic acid will chelate one atom of bi valent

metals, therefor small quantities of glycolic acid are required for chelating metal salts, reducing the cost of such compositions.

Glycolic acid also acts to control the inhibitory effect that ammonium has on phosphates, thus allowing the effective use of a low cost source of nitrogen (the ammonium).

Glycolic acid is more effective than mineral acids in controlling pH. Only 60% weight per volume is required for lowering the pH as opposed to higher amounts of sulfuric acid required for the same. Chelating of metal salts, using glycolic acid, can be achieved in a wide range of pH conditions, even as radical as pH 2 or 9.

Glycolic acid can act as a bacteriostat, eliminating the growth of any bacteria above a certain level. The same is true for eliminating the growth of alga and fungous. Thus glycolic acid provides continuous sanitation to the irrigation system and to the soil and crop. Using glycolic acid containing compositions maintains the presence of useful bacteria such as nitrification bacteria.

Due to its chelating properties glycolic acid is an effective cleaner of scale and salts from the irrigation systems.

Glycolic acid is readily biodegradable, decomposing to water and CO2 by bacteria present in the soil so that it is not hazardous to people or to the environment as are the other chemicals commonly used in agriculture.

The use of glycolic acid in agriculture is beneficial for each of these above mentioned parameters and the combined effects of the glycolic acid further provide a method for maintenance of the irrigation systems. Maintenance of the irrigation lines and controlling crop growth may be simultaneous, as the said compositions may be administered to the crops through the irrigation system, thereby allowing dual action of the glycolic acid on the pipes and on the crops, or the compositions may be applied to the irrigation lines and to the crops separately, or different compositions (different glycolic acid concentration and /or different additions to the glycolic acid) may be used in controlling crop growth and in maintenance of the irrigation systems.

Some examples of preferred embodiments of the present invention are as follows:

Composition A

material	% in weight	optimally
glycolic acid	5 - 50	15% of a 70% stock
phosphoric acid	5 - 20	15% of a 85% stock
water (tap water)	90 - 30	70%

Composition A is a source of phosphate nutrition and has the following attributes:
Potent pH control, control of precipitation of scale in the irrigation system, keeping it clean of plugs, chelation of metallic ions, such as calcium, that are present in irrigation water, making them available for the crop to consume, decreasing the formation of insoluble phosphate as a result of the presence of ammonium in the irrigating water, controlling bacteria growth.

The concentration of each of the acids is variable depending on the plant bed type, chemistry of the irrigation water and the specific needs of the plant.

Composition B

material	% in weight	optimally
glycolic acid	1 - 25	10% of a 70% stock
manganese sulfate	0.2 - 20	2.02%
zinc sulfate	0.1 - 10	1.01%
copper sulfate	0.1 - 10	0.15%
ferrous sulfate	3 - 10	6%
ammonium hepta molibdate	0.01 - 1	0.11%
water (tap water)	add to 100%	add to 100%

Composition B is useful for micro element nutrition but not for control of pH levels or for control of bacteria growth. All the metallic ions in this composition are chelated by the glycolic acid. The unique character of this composition is its ability to keep the metallic ions in chelation in a wide spectrum of pH (pH 3 to 10). Recommendations for

the concentration of each metal and the interaction between the ions, were obtained from the Israeli Ministry of Agriculture.

Composition C

material	% in weight	optimally
glycolic acid	1 - 25	20% of a 70% stock
ferrous sulfate	3 - 24	12%
manganese sulfate	0.2 - 20	4%
zinc sulfate	0.2 - 20	2%
copper sulfate	0.1 - 10	0.3%
hepta molybdenum	0.1 - 1	0.22%
phosphoric acid	5 - 25	12%
water (tap water)	add to 100%	58%

Composition C is useful in non soil plant beds. This composition will perform as a pH controller, micro element chelator, a source of phosphates, a bacteriostat and an irrigation system cleaner. The exact dose of the composition should be with compliance to the pH demands of the plant bed. When the irrigation water is alkaline the metallic ions tend to precipitate, and their availability to the plant is lowered. Thus, the amount of metallic ions that are available to the plant is proportional to the alkalinity of the irrigating water. Bringing the pH of alkaline water to a level fit for plant growth requires a large amount of composition C. Using composition C the large amount of metallic ions will compensate for the poor availability of these elements when the irrigation water is alkaline.

Composition C supplies the plants with micro elements, controls pH levels, supplies phosphate and bacteriostat activity. The only supplement needed for complete plant nutrition is a source of nitrogen and a source of potassium. This reduces the cost of fertilizing by 40%. Offering such a cost effective approach to low profit agriculture will make food production more attractive.

Composition D

material	% in weight	optimally
glycolic acid	3 - 30	21% of a 70% stock
ferrous sulfate	3 - 10	6%
water (tap water)	add to 100%	72%

Composition D is useful for feeding iron to plants that do not need feeding of the other micro elements. The low molecular weight glycolic acid acts as a potent chelator, thus lowering the cost of iron feeding of plants.

Composition E

material	% in weight	optimally
glycolic acid	2 - 50	99% of a 70% stock
copper sulfate	0 5 - 6	1%

Composition E is useful with picked flowers, prolonging the life time of these flowers. The combination between the glycolic acid and the copper ions results in a very potent biodegradable sanitizing mixture useful in prolonging picked flowers life time.

Composition F contains glycolic acid in the right concentration together with a suitable biofilm and is useful as a biocide. In the proper concentrations, composition F will eliminate alga, fungi and bacteria, in a very short time, without damaging the plant. This composition can be used to cure leaves, roots and plant bed diseases.

The said invention will be further illustrated by the following experiments. These experiments do not intend to limit the scope of the invention but to demonstrate and clarify it only.

Experiment 1 - composition A

Composition A was fed into the irrigation water of a nursery in the lower Golan Heights, Israel. The plant bed in this nursery was grounded volcanic rock that contained a lot of iron and other micro elements such as zinc, mangan, copper etc. The irrigation water was alkaline. In this nursery the irrigation system was clogged, there were a lot of chloretic plants as a result of insuficient iron and microelement nutrition and a lot of plants were dead as a result of root disease.

Composition A, adjusted to a pH of 5.5, was applied to the plant beds for a period of two weeks. The results of the treatment with this composition were:

- A steady pH of 5.5 was maintained throughout the irrigation system.
- The irrigation system was completely clean of scale and plugs and no dry spots were observed in the plant beds.
- The level of dissolved iron in the irrigation water rose from 0..5 ppm to 0.5 ppm and after another couple of weeks of treatment the iron reached an optimum of 1.2ppm.
- Chloretic plants disappeared.
- The number of root sick plants was dramatically reduced.

Experiment 2 - composition B

In a mango plantation on the sea shore in Israel, chosen for this experiment, the soil was salty, alkaline and contained a lot of insoluble calcium and magnesium salts The irrigation water was also alkaline. In the winter, salty winds, coming from the sea, damaged the tree leaves. These conditions made the growth and fertility of the plantation very low and uprooting of the plantation was considered. All known options of micro element nutrition were tried, with no success.

Composition B was applied to the plantation and after a period of ten days, a dramatic change took place in the plantation. As a result of the availability of micro elements to the trees a new healthy growth began after a year of no growth at all.

Experiment 3 - Composition C

Composition C was fed to irrigation water of an alkaline nature. This water was used to irrigate roses in a green house in which the plants were planted on synthetic plant beds. The pH of the water, before addition of composition C was 8. Addition of composition C brought the pH to 5.5. Composition C was supplemented only by KNO_3 and urea. After several weeks of application, the growth and well being of the plants was improved. The level of micro and macro elements in the plant bed and in the plants' leaves, increased and it was calculated that the cost of iron feeding of the plants was reduced by 40%.

Claims

1) Agricultural composition useful for controlling crop growth and for the maintenance of irrigation systems, containing as an active ingredient glycolic acid.

2) Agricultural composition according to claim 1 wherein the composition is an aqueous solution containing up to about 72% by weight glycolic acid.

3) Agricultural composition according to claim 1 wherein the composition is comprised of a mixture of glycolic acid and phosphoric acid.

4) Agricultural composition according to claim 1 wherein the composition is comprised of glycolic acid and metal ion compounds.

5) Agricultural composition according to claim 4 wherein the metal ions are bivalent metal ions.

6) Agricultural composition according to claim 4 wherein the metal ions are selected from: iron, zinc, copper, manganese, molybdenum, calcium, magnesium.

7) Agricultural composition according to claim 1 wherein the composition is for use as a fertilizer.

8) Agricultural composition according to claim 1 wherein the glycolic acid of the said compositions chelates calcium deposits, or the like, in the irrigation lines.

9) Agricultural composition according to claim 1 wherein the composition is useful for macro element nutrition.

10) Agricultural compositions according to claim 1 wherein the composition is useful for micro element nutrition.

11) Agricultural composition according to claim 1 wherein the composition is useful for controlling the pH level of the irrigation water and of the soil.

12) Agricultural composition according to claim 1 wherein the composition is useful as an antimicrobial or a bacteriostat.

13) Agricultural compositions as hereinbefore described and illustrated.